

REMARKS

The subject invention relates to certain improvements in the electrode structures used in gas discharge lasers and in particular excimer type lasers. Figure 1 of the subject specification illustrates the general configuration of the discharge chamber. The gas discharge is excited between two opposing electrodes 108. As can be seen from Figure 1, the actual excitation region occupies a small portion of the upper area of the discharge chamber. A blower 106 functions to rapidly circulate the gaseous gain medium around the chamber and through the electrode region. This fast exchange of gas permits operation at high repetition rates.

Because of the need for a relatively fast flow of gas past the electrodes, care must be taken in their design so that unnecessary turbulence is not created. Accordingly, in the past, it has been known to use non-conducting members shaped to improve the flow of gas past the metal portions of the electrodes. An example of the use such a non-conducting flow members (16) is shown in U.S. Patent No. 5,247,534, to Muller-Horsche, cited by the Examiner and assigned to the same assignee as herein. These non-conducting members are often referred to as spoilers and are shaped to minimize turbulence.

One aspect of the subject invention relates to an improve approach for attaching a ceramic spoiler to the electrode. This approach is described in the specification beginning at page 6, line 4, in conjunction with Figure 3. As seen therein, the electrode body 302 is provided with a channel 310 which has tapered side walls. The width at the opening the channel is smaller than the width at the base of the channel. The spoiler 304 is provided with a tongue 314 which projects into the channel. The tongue has tapered side walls which increase in width. During assembly, the tongue of the spoiler is slid into the groove of the electrode from one end thereof. A spring 316 is inserted into the opening in the channel and biases the tongue into the side walls of the channel. By this arrangement, the spoiler is held in a fixed position with respect to the electrode.

As noted in the specification, this approach has a number of advantages over the prior art. First, the need for screw connections between the electrode and spoiler are eliminated. Second, since the springs are not rigidly attached, they provide some flexibility and stress relief between the ceramic and metal elements when the laser heats up and cools down. Applicants have amended claim 11 and added new independent claims 38 and 42 to focus on this aspect of the subject invention.

Another aspect of the subject invention is an improved shape for the electrode. This shape is common to both the Figure 3 and Figure 7 embodiments. More specifically, the electrode includes a generally hemispherical or arcuate structure formed from a ceramic material for improved gas flow and reduced turbulence. In addition, the electrode includes a central, projecting nose portion (306, 712) which is designed to improve discharge ignition performance. This overall geometry is the subject of amended, independent claim 1. It is submitted that all of the currently pending independent claims distinguish over the prior art of record, whether taken alone or in combination.

Turning to the Office Action, the Examiner objected to claim 12 as having an incorrect dependency. Claim 12 has been cancelled so this objection can be withdrawn.

In the Office Action, the Examiner first relied upon the patent to Cirkel (5,142,547) for its teaching of electrodes E1 and E2 with ceramic “spoilers” 10. First, it not at all clear whether the ceramic members 10 of Cirkel are spoilers. It is clear, however, that these ceramic members are not mounted to the electrodes in a manner now covered by amended claim 11 and claims 38 and 42. The shape of the electrodes and spoilers are also different from what is now covered by amended, independent claim 1. In the Office Action, the Examiner argued that the center portion of the Cirkel electrodes includes a raised portion which is equivalent to the “nose” portion in applicants’ design. Even if this were the case, the side portions of the electrodes and the adjacent ceramic fingers 12, surrounding the nose portion, are planar. As seen in applicants’ Figures 3 and 7 and recited in amended claim 1, the outer configuration of the ceramic spoiler positioned around the nose portion is arcuate. In this manner, turbulence across the electrode body is reduced. In view of the above, it is submitted that Cirkel does not teach or render obvious the inventions of the pending independent claims.

In the Office Action, the Examiner rejected certain of the claims based on the patent to Lacour (4,495,631). Lacour teaches a laser having a pair of opposed electrodes 2 and 3 separated by ceramic members 4 and 5. The ceramic members of Lacour are not mounted to the electrodes in a manner now covered by amended claim 11 and claims 38 and 42. Further, the overall shape of the electrode and ceramic structure does not correspond to the structure as defined in amended claim 1. The electrodes of Lacour do include a central hemispherical portion. However, the ceramic members of Lacour are rectangular so there is no spoiler

surrounding a nose portion that has an arcuate region. For these reasons, it is submitted that Lacour does not teach or render obvious the inventions of the remaining independent claims.

In the Office Action, the Examiner relied on assignee's Muller-Horsche patent (5,247,534) primarily for its teaching of a flexible tongue and channel fitting. However, the structure of the electrodes and flow bodies of Muller-Horsche are quite different from what is currently being covered in amended claim 11 and claims 38 and 42. More specifically, in Muller-Horsche, the electrodes 10 and 10a are solid and buried in the flow bodies 16 and 32. Arguably, flow bodies 16 include a tongue which projects into a region defined by flow bodies 16a, electrode 10a and field shaping body 24. However, this configuration is quite different from applicants' claimed design which relies on a channel having a narrow width opening, a tongue having a free end wider than the end connected to the spoiler and a spring for stabilizing the positioning between the spoiler and the electrode. Accordingly, it is submitted that Muller-Horsche cannot overcome the deficiencies of the primary references in rendering claims 11, 38 and 42 obvious.

In the Office Action, the Examiner cited the patent to Fein (4,122,411) as teaching the use of a clip mount to attach a ceramic to an electrode, citing to Figure 12. Fein relates to gas laser having a substrate which is formed from glass, but could be a ceramic material. The substrate is provided with a channel (cathode volume 4 in Figures 1 and 2 and 124 in Figure 12) for receiving a cathode (electrode). The embodiments of Figures 10 to 12 relate to providing a metallization layer around the surface of the hollow cathode volume. When discussing the Figure 12 embodiment, Fein suggests that the metallization layer can be a preformed unit, held in place by a mechanical clip. While Fein therefore teaches that a clip can be used with a laser, its teachings are quite unrelated to the claimed invention. Fein does not teach a channel having a narrow width opening, a tongue having a free end wider than the end connected to the spoiler and a spring for stabilizing the positioning between the spoiler and the electrode. Since none of the other references teach these features either, the mere teaching of a clip by Fein cannot render amended claim 11 and claims 38 and 42 obvious.

In the Office Action, the Examiner cited the patent to Malburg (4,257,102) for its teaching of mounting structure of Copper-Beryllium alloy covered by nickel. The Examiner cited the patent application to Kojima (2002/0001329) for its teaching of preionization. The Examiner cited Hofmann (RE38054) for its teaching of bearings. The Examiner cited a Barden


publication ("Precision Bulletin, 2/21/2000) for its teaching of high nitrogen-alloyed martensitic steel bearings. Finally, the Examiner cited the patent to Andronica (5,957,017) for its teaching of a dry film lubricant of tungsten disulfide. It is respectfully submitted none of the secondary references overcome the deficiencies of the primary references in anticipating or rendering obvious applicants' invention as defined by amended independent claim 1 and 11 and new claims 38 and 42.

For the reasons set forth above, it is respectfully submitted that the pending independent claims define patentable subject matter and allowance thereof, along with the claims depending therefrom is respectfully solicited.

Respectfully submitted,

STALLMAN & POLLOCK LLP

Dated: February 9, 2006

By: 
Michael A. Stallman
Reg. No. 29,444

Attorneys for Applicant(s)